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Editorial

Special Issue "Symmetry in Human Evolution, from Biology to Behaviours"

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Our knowledge of human evolution has made particular progress over the last twenty years, thanks to the discovery of new fossils and the use of new methods and multidisciplinary approaches. This consideration may seem true for all periods since the beginnings of prehistoric sciences. Nevertheless, the accumulation of data and knowledge seems particularly notable lately. At present, this allows us to approach, with more ambition, complex subjects on the margins of research in paleoanthropology. In particular, studies of departure from symmetry, including variations in fluctuating or directional asymmetries, have contributed to the expansion of this knowledge in various fields of paleobiology and archaeology. This Special Issue brings together articles dealing with symmetry and human evolution. Eight papers are original studies, proposing either new tools to investigate bilateral variation or new results on the brain, skull or skeletons during human evolution. Finally, two papers are reviews of the state of the art of our knowledge of limb preferences in the animal kingdom, and of the potential (and future) interactions between paleoanthropology and the field of neurosciences.

Lin et al. [1] proposed an original approach while quantifying and visualizing the variation in endocast asymmetry in modern humans using diffeomorphic surface matching. This type of development is important in order to break free from the limits related to techniques that require 2D or 3D landmarks, but also because it is thus particularly suited to the particularities of work on the brain endocast. Their results are congruent with well-documented classical anatomical asymmetry of the human brain/endocast, proving the validity of such a new methodology.

Hurst et al. [2] addressed bilateral variation in dimensions of the occipital lobes in chimpanzees. This anatomical area has been the subject of much discussion about the supposed characteristics of different species during human evolution. This work on 83 specimens brings us information on the anatomical variation in the shape and proportions of the occipital lobes in our closest living relatives.

Zhang and Wu [3] investigated bilateral variation in morphometric data of the cerebellar lobes on virtual endocranial casts of a large sample of fossil hominin species, including *H. neanderthalensis* and *H. erectus*, and a comparison with *H. sapiens*. This anatomical area is known to have a specific morphology in our species compared to other hominins. It is interesting here to see information for a unique fossil sample and to observe differences in terms of shape and in bilateral variations among hominins.

Buzi et al. [4] performed a virtual reconstruction of an important fossil specimen, the Stenheim skull. This fossil is highly distorted, making the description of its anatomical traits difficult. The obtained retrodeformed model of Steinheim will be of interest for future studies of the craniofacial variation among Mid-Pleistocene hominins.

Melchionna et al. [5] proposed a new R tool that allows for automatic numerical quantification of fluctuating and directional asymmetry. Moreover, it produces a chart of the quantified bilateral variation directly on the analyzed 3D model. This graphical production gives immediate visual information on the intensity, topology and direction of departures from symmetry, being a useful tool for description and illustration.

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Profico et al. [6] proposed a new tool added to an R package to assess the lateralization of the distribution of cortical bone along the entire diaphysis of long bones.

Zhao et al. [7] were interested in a regularly studied subject, the bilateral variations in the biomechanical properties of the humeri. However, they proposed a novel approach. Instead of conducting qualitative comparisons at a limited number of locations along the diaphysis, they included a comparison of biomechanical asymmetries quantified by morphometric mapping all along the length of the bone. This approach is informative and promising as it details more complex and subtle variation in the analyzed parameters in the different parts of the humeral diaphysis.

Bardo et al. [8] aimed to investigate the link between the form and the function of the human hand and also deal with the question of human laterality and dexterity. To do so, they measured grip strength in a very large sample of volunteers and tested the potential effects of age, sex, asymmetry (hand dominance and handedness), hand shape, occupation and practice of sports and musical instruments that involve the hand(s). This original study gives original detailed information and is particularly interesting from the perspective of trying to decipher the evolution of human behaviors and capacities.

Boulinguez-Ambroise et al. [9] detailed the state of the art of the knowledge on the limb preferences in animals in order to contextualize how recent research has revolutionized our perception of the specificities of manual laterality in hominids, and how we now study those aspects. New methods, such as functional neuroimaging, but also original developmental approaches are crucial today to propose a new vision of the mechanisms underlying human handedness.

Finally, Balzeau and Mangin [10] discussed the recent developments of their respective fields of research, namely, paleoanthropology and neurosciences. In the future, the contribution of neuroimaging will allow us to better define the relationship between the brain and its reflection on the internal cranial bone surface, the endocast, which is the only material available for fossil hominins, to approach the evolution of the human brain. Moreover, documenting the anatomy among past human species and including the variation over time within our own species are approaches that offer us a new perspective through which to appreciate what really characterizes the brain of humanity today.

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